Meridional Overturning Variability Experiment

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Project Summary

A present gap in the sustained ocean climate observing system are techniques and programs for monitoring the circulation and mass/heat/freshwater transports of major current systems. Depending on the intensity, width, and depth extension of the current to be observed, different approaches and technologies exist now which allow implementation and maintenance of such "transport reference sites". For broad-scale and deep-reaching circulations, a recently demonstrated method consists of fixed-point installations with moored and bottom-mounted instruments to obtain horizontally and vertically integrated measurements throughout the watercolumn. The MOVE project intends to maintain the developed elements of the first such system by taking over partial operation of a moored transport array in the Atlantic.

In the year 2000 the German CLIVAR programme initiated the circulation monitoring array (MOVE) in the subtropical west Atlantic along 16N, in order to observe the transport fluctuations in the North Atlantic Deep Water layer. Since then, three "geostrophic end-point moorings" plus one traditional current meter mooring on the slope have been used to cover the section between the Lesser Antilles (Guadeloupe) and the Midatlantic Ridge. The goal is to determine the transport fluctuations through this section, using dynamic height and bottom pressure differences between the mooring for estimates of the geostrophic transport.

To date, the array has delivered over 90% data return, and due to the built-in redundancy, transports are available for the full 6-year deployment period from German funding. The goal of the NOAA project is the continuation of the MOVE transport array in a reduced form (2 endpoint moorings plus current meter mooring on the slope), while complementing it on the eastern side of the Atlantic with a German-funded and operated mooring (near the Cape Verde islands). Numerical simulations by T.Kanzow (Ph.D. dissertation) have shown high skill of such an ocean-wide system for capturing the total meridional NADW transport across the latitude line, and IfM-Geomar/Kiel has committed to cooperate by providing the eastern end-point mooring.

With the new MOVE project, SIO will operate the two geostrophic endpoint moorings between the western boundary and the Midatlantic Ridge, plus the small current meter mooring on the slope. In the first years, the acquisitions for complete configuration of the moorings will take place, and the array will gradually be built up to its full implementation. In later years, routine operation will be achieved, and routine delivery of indicators about the state of the thermohaline overturning circulation at this latitude will be enabled.

FY 2007 Progress

In the reporting period, the MOVE mooring array was serviced on a German research cruise in December 2006, see map in Figure 1. The prior moorings, all still with German equipment, were recovered, and data were retrieved. The data from the moored instruments are complete and of good quality. Raw data processing has been performed, and scientific data analysis is now possible with the data.

Figure 2 shows a preliminary analysis of the geostrophic transports relative to 5000db, including the entire timeseries at hand to date. Figure 3 contains the upper-ocean (0-1000m) temperature anomalies at mooring M3 from the last deployment period (due to the boundary current there are large mooring subduction/knock-down events).

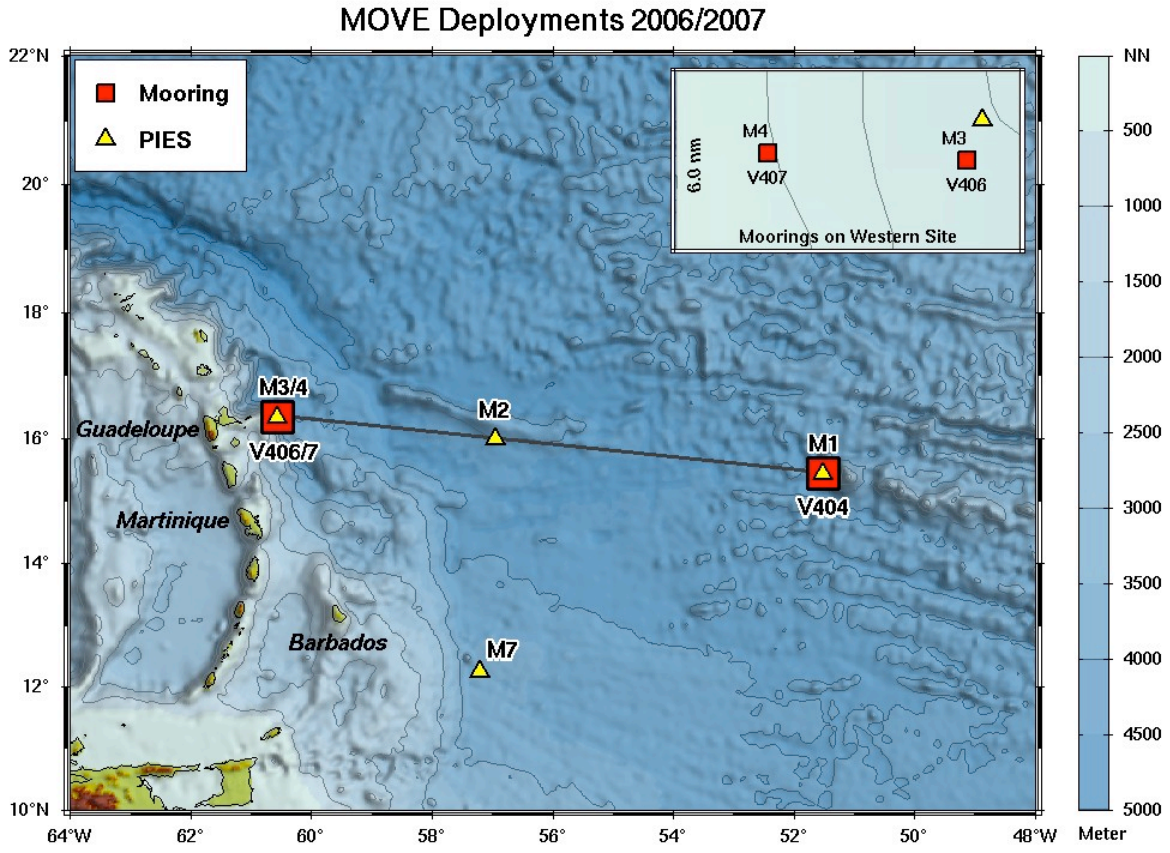

Figure 1: *Map of MOVE moorings M1, M3, M4, and pressure sensors/inverted echosounders (PIES) at locations M1, M2, M3, M7.*

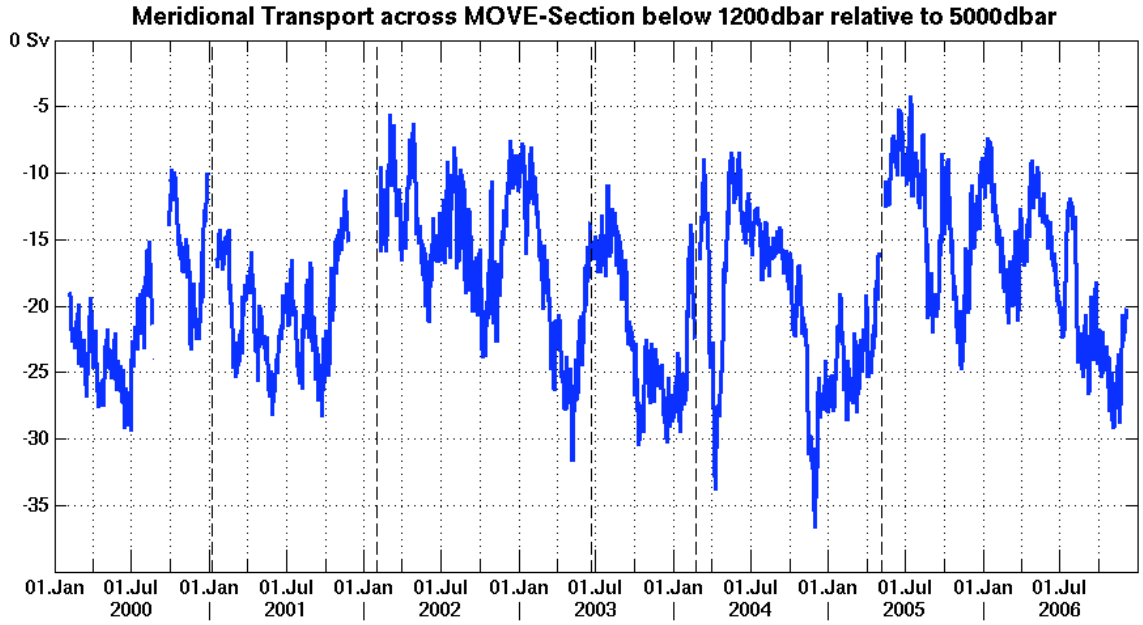

Figure 2: *Timeseries of geostrophic transport between M1 and M3 in the deep water layer (1200-5000db) relative to 5000db. The deployment periods are separated by dashed lines, the last segment represents preliminary data recovered during the reporting period.*

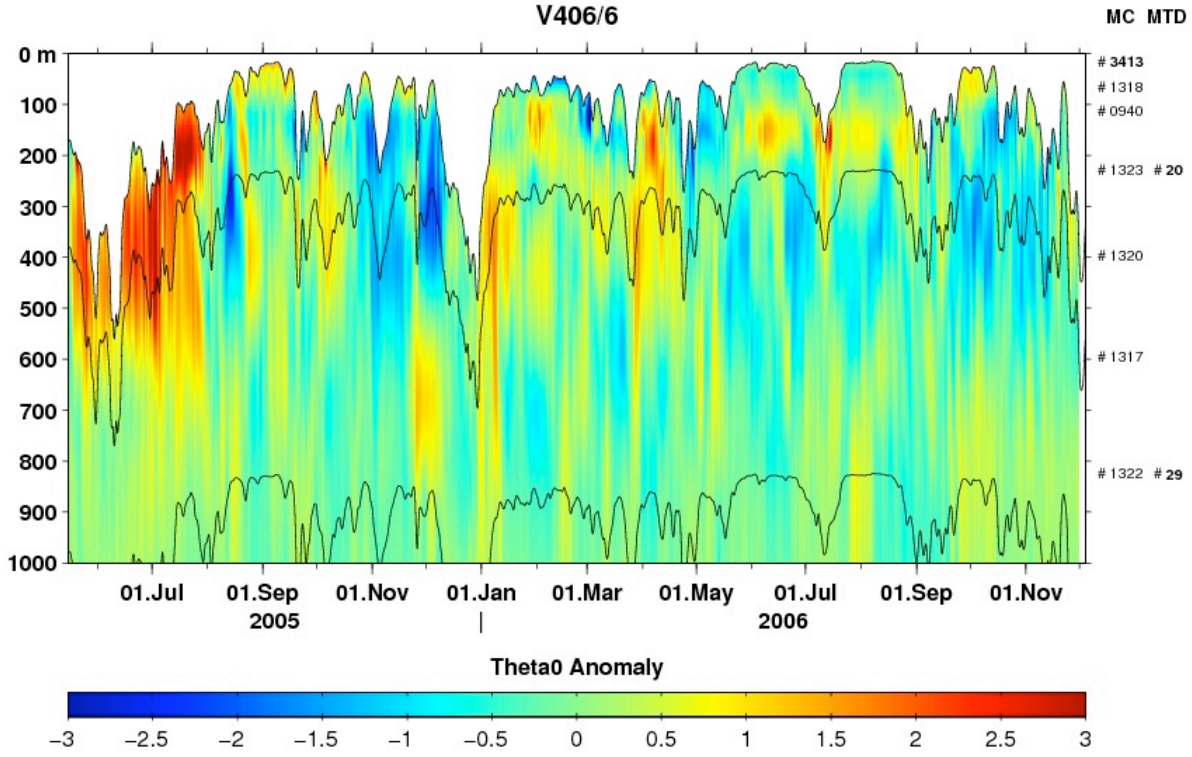

Figure 3: *Potential temperature anomalies in the upper 1000m at mooring M3.*

The moorings were re-deployed during the same cruise in a nearly equivalent configuration, but now with a majority of NOAA funded equipment (but not all). The tables below give information about the moorings deployed and the material contained in them. Much of the items marked as "SIO" were purchased with NOAA funding. The mooring design of mooring M3 shown in Figure 4 gives the typical layout, even though M1 covers only the deep-water layer (and does not reach near the surface like M3).

Mooring Deployments during cruise MSM 04/1, December 2006

Site	*Mooring ID*	*Position*	*Water Depth*	*Depl. Date*
M4	V407/7	16N20.25 60W36.75	3010m	06-Dec-2006
M3	V406/7	16N20.01 60W29.86	4944m	07-Dec-2006
M1	V404/7	15N26.95 51W30.51	4970m	12-Dec-2006

Mooring Instrumentation and Equipment

Site	*Aanderaa RCM*	*Seabird 37 MicroCat*		*Acoustic Release*	*Float, 17" Glass Sphere*	
		inductive	*serial*		*Benthos*	*Nautilus*
M4	4 IFM	-	-	2 SIO	26	10
M3	3 IFM	21 SIO	-	2 SIO	41	24
M1	-	9 SIO	6 IFM	2 IFM	18	26

Each Mooring is equipped with 2 Elkins Titanium swivels, in total 6 swivel are deployed (SIO owned).
Each Mooring has a Top-Float (Aluminum Frame with 2 Benthos Floats), equipped with
- an Argos-Beacon, owned by SIO
- a VHF-Radio-Transmitter, owned by SIO
- a Xenon-Flasher, borrowed from Marfac (SIO)

During the December '06 cruise, it was determined that the inverted echosounders with pressure sensor (PIES) had all stopped recording due to a battery and design flaw by the manufacturer. Most of them could be recovered, since they have a separate battery for the release mechanism. Therefore we participated in the NOAA NTAS cruise in April 2007, and new PIES were then deployed that now have the problem corrected. The table below gives the relevant information for these new PIES which are in the water at present.

PIES Deployments during cruise RB-07-02, April 2007

Site	*PIES s/n*	*Position*	*Water Depth*	*Depl. Date*
M3	197 SIO	16N21.36 60W29.33	4955m	15-Apr-2007
M2	127 IFM	15N59.28 56W56.29	4943m	23-Apr-2007
M1	180 SIO	15N27.04 51W31.62	4965m	24-Apr-2007
M7	128 IFM	12N15.47 57W12.07	4454m	17-Apr-2007

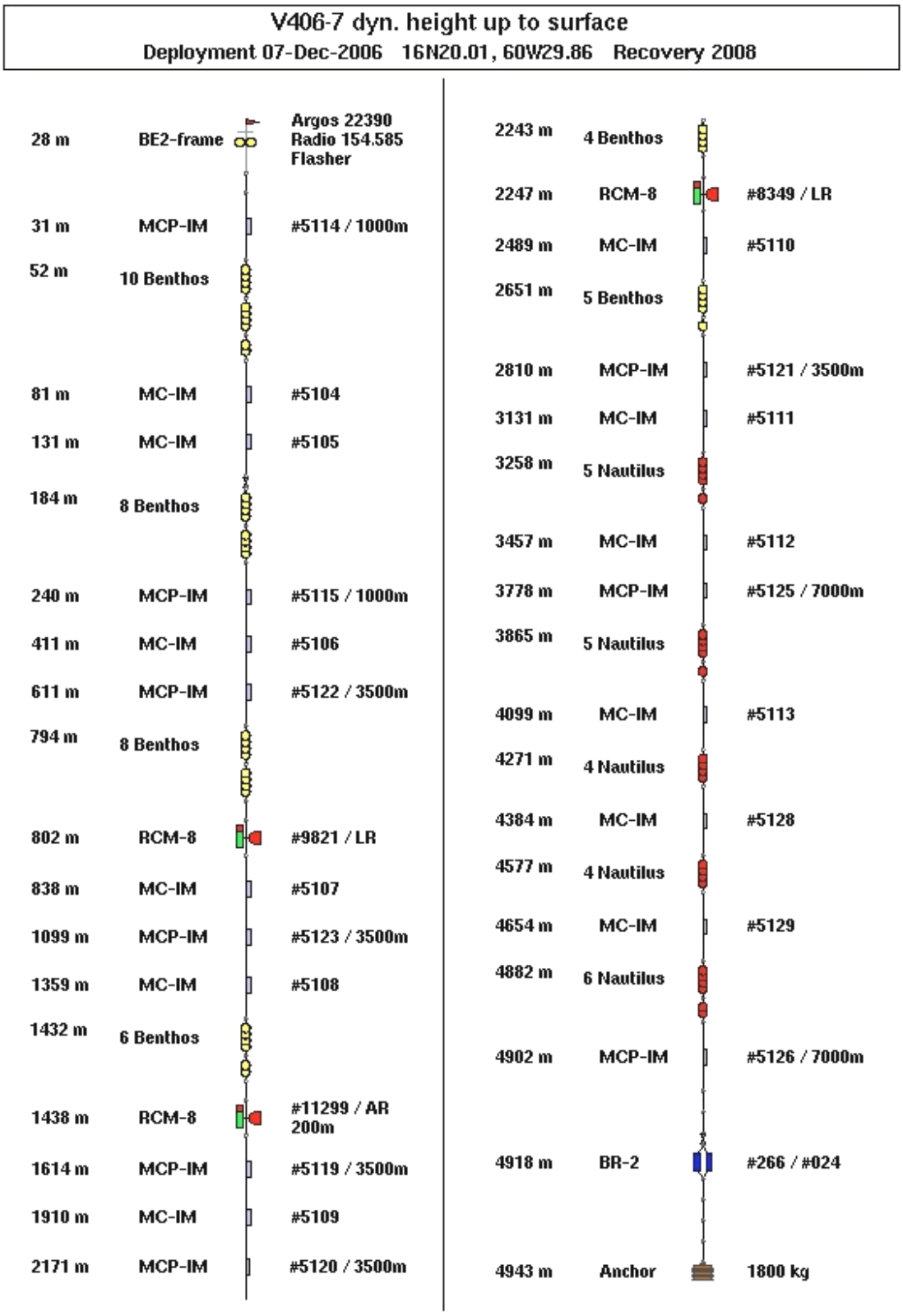

Figure 4: *Design of mooring M3 with each instrument and its depth noted.*